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HUMAN LIFE IN THE ARCTIC

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IN the Northern Hemisphere the continents extend into the Arctic zone so as to nearly enclose the Arctic Ocean which spreads over the north polar region, contrasting strikingly with the conditions in the Southern Hemisphere, where a continent, surrounded by water, occupies the south polar region. In the far south the water has served as a barrier and the Antarctic is consequently an uninhabited region; but in the encircling northern land, a continuation of a region readily habitable, it is not unnatural that human beings should have pushed the zone of habitation to the very northern border of the continents.

Thus it happens that there is a sparsely settled coastal fringe all the way from northern Norway, across northern Asia and North America to Greenland; but in the short space between Europe and Greenland there is no aboriginal population either in Iceland or Spitzbergen, the ocean barrier having been effective in preventing the spread of primitive people to these islands. From the coastal fringe there are narrow ribbons of population along the larger rivers; but over large areas between the rivers, back from the coast, there are few, if any, human beings. In America the interstream areas of the Arctic region are practically unoccupied; but in northern Eurasia, where the aboriginal population has learned the use of the reindeer, this zone has been found favorable to a sparse population; and in the extreme west of Eurasia the modification of the Arctic climate by the warm west winds has made possible the Lapland settlements of northern Norway, Sweden and Russia.

LIMITATIONS TO HUMAN LIFE

The sparseness of this Arctic population, and its distribution, are due to the limited food supply found in such high latitudes, not directly to the cold and winter darkness; for, given food and materials for clothing and shelter, man can survive amid even the most adverse climatic conditions known on the lands.

One of the chief limitations to human life in the frigid zone is the fact that, throughout the greater part of the land in high latitudes, the

climatic conditions are unfavorable to the growth of food-producing plants. There are local exceptions, as on the coast of Norway where grains are raised within the Arctic zone; but, in general, all forms of agriculture are prohibited. It is true that the native plants supply a few berries that have some value as a partial food supply; but these cannot be considered basal in importance. The soil is normally frozen to a great depth, thawing out only at the very surface during the summer months, and this frozen state is unfavorable to the growth of trees, although on the southern margin of the tundra scrub forests exist in some portions of the Arctic zone, as for instance in Alaska and in Lapland. Normally the tundra flora consists of annual and perennial plants with a few low shrubs and many mosses and lichens.

This herbage suffices to support life of scattered herbivorous animals, notably the reindeer and musk-ox among the mammals, and the ptarmigan among the birds; and a few carnivorous animals preying upon these are also found. But there is far too little of such land life to furnish a steady food supply for even a sparse population. Thus neither the plant nor the animal kingdom offers opportunity for sustenance on the Arctic lands.

When the fish in the rivers are added to such food supply as can be obtained from the land animals and plants, there is sometimes a sufficient food basis for scattered aboriginal life. This is one of the chief reasons why there are ribbons of population along the larger streams, the other reason being the opportunity that the rivers offer for free movement, thus enlarging the territory from which the food supply may be drawn.

THE SEA AS A SOURCE OF FOOD

In striking contrast to the land, there is a marked development of animal life suitable for food along the coast; and this, together with the scanty supply of food from land animals and plants, is the basis upon which the Eskimo and other northern people depend. The Arctic coast in summer is the seat of abundant and varied life. Minute animalculae abound in these cold waters, as is proven by the fact that the largest of animals, the whale, subsists upon them; and many lowly forms of life exist on the shallow sea bottom, forming the food supply for swimming and diving animals, including the seal and walrus among the mammals, and large numbers of swimming and diving birds. To these may be added the polar bear which preys primarily upon the seal.

The larger mammals exist in sufficient numbers to furnish the main support of the coastal people, though they depend in part upon fish and upon the sea birds which exist in vast numbers, nesting upon the rocky cliffs and barren islands. The abundance of this bird life in summer is almost inconceivable; but by the time the winter cold has sealed the Arctic seas most of the birds have migrated to southern regions where open water permits them to obtain their normal food supply.

THE UNCIVILIZED ESKIMO

Among the Arctic people the Eskimos offer the best illustration of the influence of geographic environment. These people, numbering perhaps 30,000 in all, are spread in scattered settlements from just west of Bering Straits to the eastern coast of Greenland, fringing the mainland and also occupying the coast of some of the islands. Formerly throughout this area, and at present in those places out of reach of the influence of white men, the Eskimos have been engaged in one of the most serious struggles against adverse geographic conditions of any people in the world.

To the land they can look only for a very small contribution in the form of berries and the scattered land animals. They must look out to the sea not only for the bulk of their food, but also for materials for clothing and shelter. Only by the hardest struggle, constantly kept up, and by the exercise of intelligence, energy and ingenuity, is it possible for them to maintain life amid such surroundings. Since the food supply is shifting and uncertain, it is not usually possible for them to have fixed homes; they must ever be ready to move from point to point when the food supply fails. Consequently, though not strictly nomadic, they are migratory within a narrow range.

This necessary mode of life of the Eskimo places a distinct limitation upon the amount of property that can be accumulated, for anything in excess of actual needs must be left behind when the time for moving comes. The boat (kayak) which the men use in hunting, the large skin boat (oomiak) in which the women and children move the property from place to place, a few skins for cover and for tents, the clothing which they wear, and a few simple implements constitute the outfit of Eskimo communities. The winter home is of ice or snow, suitable not merely because of the abundant supply, but also because it is easily worked and quickly built into the igloo form, and because it furnishes the best of shelter against the Arctic cold. The summer home consists of a few skins thrown over upright supports, usually the bones of large animals; easily put together, easily taken down, and easy to transport. For fuel in winter the blubber of the seal or walrus suffices, and in summer little or no fuel is used, since meat is relished in the raw state.

To hunt their food supply upon the sea it is necessary to have provision for expeditions both in summer and in winter. This necessitates a boat for summer, when the ice is partly or wholly absent from the sea, and for winter a sled to be drawn over the frozen surface. For the latter purpose dogs are used as motive power, and were it not for the fact that these people have learned to make use of the dog as a draft animal it is highly probable that life could not be sustained over most of the area now occupied by the Eskimo.

In the making of the boats, sleds, and implements of the chase, very great ingenuity is shown in utilizing the limited resources to meet their needs. The boat is made of skin wrapped around a frame of bone or, where possible, of wood that has drifted ashore. The hunting boat, or kayak, is long and narrow and can be propelled through the water with great rapidity, this being necessary in the seal hunt. Since swiftness interferes seriously with stability, and consequently with safety, the boat is decked over with skin, excepting at one point in the middle where a round hole is left open for the Eskimo to sit in; and when he has taken his place in the kayak, the skin is drawn around his waist so that he essentially becomes an integral part of the boat, propelling it with his double-bladed paddle. Under such conditions an upset is not accompanied with the same danger as in an open boat, for the occupant can skillfully right the overturned kayak which, because of its deck, ships no water. In the Alaskan region, the Eskimo use the bidarki, a modification of the kayak, with two or more holes instead of one. The woman's boat, or oomiak, also a skin boat stretched upon a bone or wood frame, is a far clumsier boat and is used only for the slow process of carrying the camp outfit, and the women and children, from point to point.

The Eskimo in his kayak carries spears for birds, fish and seal, all ingeniously contrived, and mainly made of bone, ivory and sinew. He must travel rapidly, and far and wide, often amid floating ice, and often exposed to the danger of winds and storms. There is constant effort, and abundant danger.

The winter sled is also an ingenious contrivance made of bone, or wood and bone, fastened together with thongs, shod with bone or ivory, and attached to the dog team with sinew. The sled is moved freely about over the frozen sea, and long journeys must often be made. It is during this season that the greatest danger comes to the Eskimo hunter, for his prey can be found only at those holes or breaks in the ice where it rises to the surface to breathe, and these he must locate and patiently watch. During this hunting seaeson, the bitter cold and the darkness of the winter night are added to the difficulties that the Eskimo must endure. Many are the times when a hunter fails to return from the winter chase, or, after several days of the hardest work, returns without success. Many are the times that it becomes necessary to move the village, and not uncommonly starvation stares the Eskimo in the face.

It is not to be wondered at that, under such conditions, there has developed a socialistic habit of sharing property; for a seal brought in by a successful hunter may be necessary to save the life of the unsuccessful. Nor is it to be wondered at that when starvation is imminent the old and weak are first allowed to perish. Nor is it remarkable, as has been asserted, that death comes to Eskimo men mainly from accident, rather than disease; and that old men are not numerous in Eskimo colonies.

Under these conditions of life it naturally follows that there can be no large settlements, for success depends upon scattering, otherwise the food supply in a locality would soon be exhausted. It also follows that there must be frequent movements in search of better hunting grounds. The development of the idea of individual property is thus checked, and even the accumulation of property by a group is also undesirable. Naturally, also, there can be no efficient tribal organizations, and no chiefs or rulers. The natural mode of life is in small, migratory communities, keeping within a somewhat restricted area, each family being in a measure independent of the others, though subject to draft upon their resources if they are more successful than their associates. Also, the method of hunting is naturally individual, for the prey is scattered, it must be sought in as many localities as possible, and when located it must be swiftly followed. For these purposes, individuals, each in a swift boat, offer the greatest chance of success.

Such a life necessarily breeds hardiness, courage, cunning, and intelligent ingenuity; but both the severe struggle for existence and the necessary mode of life are adverse to the internal development of civilization. To the savage of the humid tropical zone life is too easy; to the Eskimo it is too hard, and the energies are used up in securing the barest necessities from a region by no means too bountiful, leaving little time or opportunity for self improvement.

THE GREENLAND ESKIMO

Along a portion of the western coast of Greenland, the Eskimos have been brought under control of a European nation—Denmark—and this has naturally brought about a very material modification in the mode of life of these Arctic people. It would take much more space than is here available to point out the full extent of the modification, though some points which stand out prominently may be briefly stated.

One of the most striking modifications is in the introduction of modern civilized weapons, notably the rifle, which has extended the power of the Eskimo as a hunter, but has had the disadvantage of killing game faster than had previously been the case. This slaughter has been encouraged by the demand of the Danes for some kind of financial return for their colonial venture. Thus seal skins, bear skins, walrus ivory, seal oil and eiderdown are obtained in excess of the needs of the inhabitants.

A second notable modification that has been introduced is in the mode of living. There is available an increased variety of material for food, clothing and shelter to be purchased from the Danes with the excess supply from the chase. European fabrics enter to some extent into the native clothing; they have acquired a taste for certain kinds of European food; and wooden houses have in part replaced the winter homes of snow

and ice and the summer tents of skin. Together with these changes has naturally come a checking of the migratory habit, and the Eskimos have tended to gather into villages, some of which have attained considerable size. Here they erect houses of wood, stone, or turf; and naturally, with the growth in size of the community, and in its stability, there has developed the necessity of some form of government, encouraged and devised, to be sure, by the Danes. Naturally, also, the idea of individual property has developed and Greenland Eskimos even with bank accounts are not unknown.

Thus in Greenland the full effect of geographic influence is modified by the superior position of civilization; for here, as elsewhere, civilized man has shown his great capacity to overcome adverse climatic conditions. With the new life that the Greenland Eskimos have learned, with the loss of skill in the use of their primitive weapons that has naturally followed, and with the decrease in their natural food supply that has resulted from the use of the deadly weapons of civilization, it is doubtful whether these people could continue to live in the present numbers if the support of the Danish government, and the means of transportation which it provides, were withdrawn. It is said that from a financial standpoint this Greenland colonial venture is a failure, and that it is maintained in spite of this fact because disaster would necessarily result if the Eskimo were now to be abandoned.

ARCTIC AGRICULTURAL POPULATION

On the very southern fringe of the Arctic zone, there are several localities where agriculture is possible, the hardier grains being raised, and domestic animals being used as a partial food supply. This phase of Arctic life finds its best illustration in Lapland where, as already noted, the reindeer extends the power of man to live amid such adverse climatic conditions. It is probable that similar life is possible in portions of Alaska, in the neighborhood of the Arctic Circle.

The densest population in the Arctic zone is in the northern part of Norway, where the Arctic climate is greatly moderated by the winds which blow so steadily from the warm ocean waters that spread along the northwestern European coast. Here we find such towns as Tromsö and Hammerfest, and many villages and hamlets besides. The agricultural lowlands are planted in hardy grains and vegetables, while cattle, sheep and reindeer graze upon the mountain slopes; but here also, as in other Arctic lands, the ocean is one of the main sources of food supply. The fiords and shallow banks are rich in food fish, and even the agricultural coastal population is, in large part, a fishing population also. In addition, a goodly number depend for their sustenance, mainly or entirely, upon the products of the sea.

THE INFLUENCE OF MINERAL DEPOSITS

When valuable mineral deposits are discovered a wholly new element is introduced into the problem of human occupation of the Arctic zone. This finds an excellent illustration also in Lapland, where a thriving town has quickly grown as a result of the development of the remarkable iron mines of Kiruna in Sweden. Even in a land as far north as Spitsbergen a town, under the name of Longyear City, has been established in latitude 78° N. because of the beginning of development of the coal beds.

Mining in Arctic North America has not as yet made great progress, though there are scattered settlements and individual miners working in various parts of Alaska north of the Arctic Circle. Most of this mining work is in placer deposits and here, as well as over a large section south of the Arctic Circle, the climatic conditions have introduced serious difficulty into this form of mining; for the ground is frozen to a great depth, and before the precious metal can be removed it is necessary to first thaw the ground in order that the gravels may be washed away from the heavy metal.

It cannot be doubted that if rich deposits of gold are discovered in Arctic Alaska, a population will establish itself there and remain as long as the metal supply warrants. Such habitation, however, is exceptional, and is made in spite of climatic conditions, solely because of the mineral wealth; for, with the artificial aids of modern civilization, man is easily able to overcome even the most adverse climatic conditions.

GENERAL CONCLUSION

Thus, because of the climate, working indirectly through the food supply upon which human beings depend, the Arctic zone is sparsely inhabited. Such occupation as is found depends in general upon the presence of a food supply in the neighboring waters and is, therefore, mainly confined to the coast line and to the rivers. The exceptions are where local climatic conditions are unusually favorable, as on the coast of Norway, and where valuable mineral deposits attract man because of the local wealth.

Under all these phases of Arctic life man is forced into a struggle to overcome adverse climatic conditions, as his fellow man is in the desert and in the lofty mountains. In each case, as an outcome of the struggle, the influence of the environment leaves its stamp on the man himself and upon his habits and customs. In few parts of the earth is this stamp more clearly and strikingly recognizable than among the uncivilized Arctic people. They are almost wholly creatures of their environment, and almost their every act and custom is a response to some environmental influence.

THE METEOROLOGICAL INTEREST OF A VOYAGE TO BRAZIL

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TO the meteorologist the voyage to and from Rio de Janeiro is of great interest. It gives a cross-section from the prevailing westerlies of the Northern Hemisphere, across the horse latitude belt, the northeast trades, the equatorial calms and rains ("doldrums"), and the southeast trades, ending at about the southern margin of the latter. To anyone who knows these wind and calm belts only from the descriptions printed in books, such a voyage gives an insight into the actual conditions of wind and weather which no amount of reading can supply. The "field-work" (if we may so term it) which can be done by the student of meteorology on such a trip is well worth the expense and the time which the two voyages necessitate. The writer has made the trip to Rio de Janeiro three times, and has come back from Rio to New York twice, and each time he has found increased interest and inspiration in it.

The instrumental equipment need not be extensive. A Richard barograph (small size) and a sling psychrometer are most important. To these may well be added some form of anemometer, a small nephoscope, and Rotch's instrument for determining the true direction and velocity of the wind at sea. The Hydrographic Office *Pilot Charts of the North Atlantic and South Atlantic Oceans* for the months, or seasons, in which the trip is made will be found indispensable. These should be cut into sections so that they will go into the pocket, and mounted on linen.

In the hope that the few simple observations which he made during his last voyage to and from Brazil, in 1910, may be of interest and possibly of assistance to other teachers of meteorology, the writer has here summarized some of the records taken from his note-book.

The start from New York was made on July 20, 1910, in the Lamport and Holt Line S. S. "Verdi." The course followed on the direct route from New York to Rio de Janeiro (stopping only at Bahia) is about southeast until the ship passes Cape San Roque, when the general outline of the coast is followed to the southward and then southwestward. The July *Pilot Chart of the North Atlantic Ocean* shows that the maximum pressure ("North Atlantic High") is about 30.25 ins. around and to the southwestward of the Azores. The winds on the northern slope of this high pressure area are southerly to westerly, these winds being relatively light on the weak gradients of summer. On the southern slope of the anticyclone the winds are northerly to easterly, the northeast trades, which are generally at their weakest in this month. The southeast trades overlap into the northern hemisphere between 0° and 5° N., becoming

the southwest monsoon over the eastern part of the ocean and along the western coast of Africa as far as about 12° N. The belt of equatorial calms extends from British Guiana east between latitudes 6° and 10° N. to longitude 30° W., and then in an east-northeast direction to near Cape Verde. Calms and light variable winds occur along the high pressure ridge about latitude 30° N ("Horse Latitudes") over the western part of the ocean.

For the first three days after leaving New York the weather was unsettled, with variable winds, followed by rain, and then changing to a southwest clearing wind. The barograph showed the passage of a faint cyclonic depression, and thus gave the typical irregular quality of the prevailing westerly wind belt. The temperature rose steadily from 70° at 8 A. M., July 21, to 79°.5 at 8 A. M., July 23, with practically nc trace of diurnal variation. On July 22, at 8:30 P. M., a fairly sharply defined lunar rainbow was seen. The barograph reached its highest reading on the afternoon of July 23 (lat. 30° 10′ N., long. 61° 45′ W.), showing the passage of the crest of the high pressure area, and on the same day the diurnal variation of the barometer began to be seen on the curve. Typical "Horse Latitude" weather, with light southwest winds, drier air (relative humidity 71 per cent) and small cumulus clouds prevailed for about one day. On the afternoon of July 23, after a calm, the wind began to blow from east-northeast, and by the morning of July 24 the northeast trade was established. The northern limit of the northeast trade in July is shown at about latitude 27° N. at the longitude where the "Verdi" crossed this line, and the steamer picked up this wind at exactly that latitude. For four days the ideal weather of the northeast trades prevailed, with temperatures between 78° and 80°, wonderfully clear blue skies flecked with typical trade cumulus clouds, growing often into cumulo-nimbus and giving short squalls of rain, and then degrading and dissolving in the late afternoon hours. The relative humidity ranged from 75 per cent to 77 per cent. There is a curious irregularity in the cloudiness of different days in the trades, some days being almost cloudless, while others are heavily clouded with cumulus, cumulo-nimbus or sometimes even some cirrus, cirro-cumulus or alto-cumulus. The occurrence of many trade showers at night suggested that nocturnal radiation aloft must have much to do with cloud formation in these latitudes.

Showers and heavy cumulo-nimbus clouds became more frequent on the afternoon of July 27 (lat. 14° 18′ N., long. 48° 51′ W.) and on July 28 (lat. 10° 11′ N., long. 45° 49′ W.) and the general feeling of mugginess, together with the fact that the barograph curve was approaching its lowest point, made it sufficiently clear, without reference to the *Pilot Chart,* that the belt of Doldrum calms and rains was being crossed. The highest temperature recorded on the outward voyage was 80°.5 (wet bulb

74°) at 8 A. M., July 29 (noon position lat. 6° N., long. 42° 39′ W.), with very light southerly wind and heavy cumulus and cumulo-nimbus clouds, the steamer being then between the southern limit of the northeast and the northern limit of the southeast trades, as shown on the July *Pilot Chart.* After about 36 hours of calms and light breezes, and showers (but no heavy downpours), the wind began to blow light from the southwest July 29. This gradually shifted to southeast on July 30 (lat. 2° 6′ N., long. 39° 32′ W.), and the southeast trades had become established.

The noon position July 29 was exactly at the northern limit of the southeast trades as shown on the July *Pilot Chart.* The barometer began to rise again, showing that the trough of low pressure had been crossed, and the temperature began to fall slowly, showing that the "heat equator" had also been left behind. On this particular voyage it happened that more rain was noted at the margins of the trades than between them, but plenty of typical doldrum weather—overcast, muggy, calm—was experienced.

The *Pilot Chart of the South Atlantic Ocean* for June-August, 1910, shows the South Atlantic "High" covering the central part of the ocean, with a maximum pressure of 30.20 ins. along about latitude 30° S. and between longitudes 0° and 25° W. The pressure gradient is much steeper to the south, in the latitudes of the prevailing westerly winds, than to the north, in the southeast trade latitudes. This being the winter season in the southern hemisphere, the southeast trades are fresher than in summer, and their constancy and steadiness of direction are more marked. Following the general distribution of pressure, the prevailing winds along the South American coast, in the region crossed on the voyage to and from Rio de Janeiro, are southeasterly (trades) to the north of latitude 20° S., and northerly from 20° to about 30° S., the latter being the general outflow on the western side of the South Atlantic anticyclone. The southeast trades, which were picked up, as just noted, on July 30, held steadily all the way to Rio de Janeiro. The temperatures were observed to fall slowly, from about 80° to 75°, and then to 72°, as the distance from the heat equator increased. The barograph showed a slow rise, as the barometric equator was left behind and the crest of the South Atlantic high was being approached, the diurnal variation, however, still continued very marked. On July 31 and August 1, when near the coast of Brazil (off Cape San Roque) it was noticeable that the trades were unusually squally, with a good deal of rain, an overcast sky, and a choppy sea. The greater velocity of the southeast trades than of the northeast trades—a consequence of the steeper winter pressure gradients in the southern hemisphere—was so distinctly observable that it attracted the attention of a good many passengers who had no meteorological interest whatsoever. On August 1 the writer noted in his log-book: "Strongest

trades I have ever seen." The rains and squalls noted on July 31 and August 1 were very marked also on August 3, when Bahia was reached. The writer observed similar conditions here on his two previous trips. The squally and rainy character of the trades along this coast in the winter months is probably due to the strength of the onshore winds at this season, and the effect of the land in causing an ascent of the air of sufficient amount to produce condensation. At Bahia the day had almost the character of a day of "general rains" at home. The sky was overcast, and it misted, or light rain fell at intervals throughout the twelve hours of the steamer's stay at that port. (temperatures 72°-73°.5; rel. hum. 89-90 per cent and over). The influence of climate upon the local crops was well illustrated in the cargo which the "Verdi" took on at Bahia: there were 2500 bales of tobacco, destined for Buenos Aires, and there was cocoa as well. From Bahia to Rio de Janeiro there were two days and a half more of southeast trades, squally at first, and then gradually becoming clearer and somewhat weaker. The wonderful harbor of Rio de Janeiro was entered early in the morning of August 6, 17 days from New York. The night fog, so common a winter phenomenon over the great bay, "burned off" soon after sunrise, and the brilliant sunshine of an ideal winter day welcomed the passengers as they landed.

The meteorological conditions during the ten days which the writer spent on land have been described elsewhere.*

The return voyage began at Santos on August 16:—hot, steaming, muggy, interesting Santos, with its wonderful docks, and its miles of steamships loading coffee. From the city of São Paulo to Santos there is a descent, down the eastern slope of the Serra do Mar, of roughly 2500 feet, and the whole trip is made in about two hours and a half. On the plateau, the barograph pen had been recording below 28 ins., and was off the paper, but during the railroad journey down to Santos the pressure rose, within an hour, to about 29.80 ins. The pen, which was purposely left on the paper during the descent—the instrument being held in the hand—made an interesting and very smooth, nearly vertical, tracing, covering more than three-quarters of the whole width of the sheet. The ordinary Richard barograph is, obviously, not well adapted for obtaining pressure records when the instrument is being transported in this way, but the curve in this case was instructive, and well worth securing.

The writer left Santos on the steamship "Voltaire," of the Lamport and Holt Line, at 2:30 P. M., August 16, 1910. Almost immediately after leaving the docks the refreshing trade breeze came as a welcome relief after the hot "dead" air of the city, and the 18 hours to Rio harbor were a delight, with light northeasterly winds, cloudless sky and smooth sea.

*"The Economic Climatology of the Coffee District of São Paulo, Brazil", *Bull. Amer. Geogr. Soc.*, June, 1911.

A day and a half at anchor in the harbor of Rio de Janeiro gave an excellent opportunity to note the higher temperatures resulting from the presence of the land (over 80° at 3 P. M.); the change from the onshore cooling breeze of daytime to the offshore breeze at night; the oppressive heat during the transition periods of calm; the formation and dissipation of the nocturnal fog. The difference between the temperatures on the windward and leeward sides of the ship at 3:30 P. M., when the onshore breeze was blowing, was 2°. In the late afternoon the sea breeze gradually died away, and about the same time the smoke of Rio settled down over the city and harbor in a greyish-brown sheet. "The famous Rio winter fog seemed, on this occasion certainly, to begin as smoke" is the entry in the writer's note-book on August 17, 1910. At 11 P. M. the temperature was 73°.5, with a light offshore breeze. The next morning at 8 A. M. the temperature was 82°, relative humidity 67 per cent; wind light, offshore; sky cloudless; nocturnal fog disappearing. The rowboats in the bay are all provided with awnings, and the lighters also have awnings for their crews, for protection against the tropical sun. From a fellow-passenger the writer obtained much confirmatory evidence of the regularity of the summer afternoon thunderstorms, both in Rio and in São Paulo. These storms come about the middle of the afternoon and not infrequently cause short circuits in the "Light and Power" installation. At such times the inhabitants habitually blame the "Norte Americanos" for giving such poor service.

One of the most interesting meteorological phenomena of the whole voyage was observed on the afternoon of August 18, in Rio harbor. The ship was lying at anchor, "Blue Peter" flying at her masthead, ready to sail for New York. At 2:45 P. M. (temperature 77°.5, rel. hum. 62 per cent), without warning, a sharp squall from the south struck the vessel, bringing thick clouds of dust from the city, and churning up the waters of the bay almost in an instant. A tug near by broke down and was drifted helpless before the wind. A small boat was capsized. At least one large steamer dragged her anchors. There was great difficulty in getting the passengers and their baggage on board from the small boats which were pounding up and down at the gangway steps. The velocity of the wind was estimated at fully 40 miles an hour. The dust was so thick that it was impossible to see more than a few ships' lengths away. About 4 P. M. the "Voltaire" weighed her anchors and started on her voyage, but it was with difficulty and at some risk that she steamed out, past the numerous steamers. At the entrance to the harbor the squall was very violent, and the sea ran high. The famous old "Sugar Loaf," guarding the entrance to the harbor, was wonderfully grand and imposing, with a great mass of cumulo-nimbus clouds behind it; the sun sinking in the western sky, and the air filled with dusty haze. This southerly squall, which lasted

with diminishing violence for about three hours, had many features in common with the dreaded *pampero* of the La Plata estuary, and was apparently closely akin to that wind. It lowered the temperature about 5°, and was indicated on the barograph curve by a sudden slight rise, not unlike the well-known thunderstorm "nose" as the German meteorologists call it. The captain of the "Voltaire" said it was the heaviest squall he had experienced in twelve years of sailing in and out of Rio harbor. The *pampero,* if such it may be termed, was followed, as the ship steamed first east and then north, by a clear sky, except for low scud clouds and the dust haze, and by a gentle southerly breeze. The next morning the sky was overcast (8 A. M. temperature 70°.5; noon, 72°; 4 P. M., 73°), and there was a general rain, followed by a slow clearing. Although it is unwise to draw conclusions concerning weather conditions over a wide area from observations made at a single station, it seemed as if the squall and the rain were part of a general cyclonic condition from which the ship escaped as she steamed north.

About 24 hours from Rio the southerly wind changed gradually to southeast, showing the approach to the southern margin of the southeast trades, the winter season *Pilot Chart of the South Atlantic Ocean* showing the southern limit of the southeast trades to be about at the latitude of Bahia. With the approach towards the warmer latitude the temperatures began to rise, slowly and gradually, towards 75° and than over 75°. Outside of Bahia there occurred again what the captain called "the usual Bay rains," those squally trade showers already noted on the voyage southwards. The prevailing wind blows offshore in the harbor of Bahia, so that the boats which ply between the steamers and the city sail out easily, but are obliged to tack, often against a strong wind, when they sail back toward the land. The cargo which was unloaded from the "Voltaire" consisted chiefly of dried beef from the cattle which had grazed on the great plains of Argentina and Uruguay.

From Bahia, on the return voyage to New York, the same great wind and calm belts are passed through as on the voyage out, but there is a difference in the ship's course owing to the stop which is made at Barbados. On the writer's return trip in August, 1910, he was once more struck with the extraordinary uniformity of his temperature observations, made three or four times daily. The difference between the readings of any one day is only a matter of a degree or two, and that between the readings of two successive days is even less. The fact that the temperatures show so very little difference, except the gradual increase with decrease of latitude, emphasized again a climatological fact of great importance. From August 22 to August 25 typical southeast trade conditions prevailed; those ideal days, with their bright sunshine, brilliant cumulus clouds, sparkling ocean and wonderfully satisfying temperatures. When off the coast near Pernambuco frequent showers were observed—the characteristic winter rains of this

portion of the Brazilian coast. After passing Cape San Roque the course for Barbados is about northwest. This means that the southeast trade is a "following" wind, and the greater discomfort experienced by the passengers on account of the heat was the result, not of a markedly higher temperature but of the lack of wind movement, the vessel and the wind having about the same direction and about the same velocity. In other words, the "sensible temperature" was higher, the actual temperature about the same.

The trades became quite weak on August 25 (lat. 0° 27′ N., long. 43° 49′ W). For three days more, to Barbados, while the "Voltaire" was crossing the Doldrums and entering the southern limit of the northeast trades, the wind was pretty steadily light southeast. There was no sharply defined Doldrum weather, and no sharp transition out of the southeast trade and into the northest trade, such as was noted on the outward voyage. From the point of view of the meteorologist this is an interesting fact, and shows clearly that the diagrams and even the generalized wind charts, give much too rigid an idea of the sharpness of the boundaries between the different wind and calm belts. It should be remembered, moreover, that there is a good deal of southeasterly wind in the northeast trade belt on the western side of the North Atlantic high, so that there is by no means a sharp contrast between the southeast and northeast trades. On the voyage in question, light southeasterly winds held, with slight interruptions, until after leaving Barbados. On August 27 (lat. 7° 23′ N., long. 53° 7′ W.) a temperature of 81° was recorded, and there were heavy cumulo-nimbus clouds in all directions, with rain, thunder and lightning in the evening. Showers continued during the following day (lat. 10° 33′ N., long. 57° 38′ W.), with heavy cumulo-nimbus clouds, and trade cumulus., the wind being southeast to east. These were the Doldrum rains, but there were no equatorial calms. The August *Pilot Chart of the North Atlantic Ocean* shows the northern limits of the southeast trades to be about 6° N., and the southern limit of the northeast trades to be about 10° N. This brings the Doldrum belt just where the "Voltaire" experienced these heavy showers.

Barbados was reached August 29. At anchor in the bay the temperature went as high as 84° at noon, owing to the close proximity of the land, although the wind was fresh southeast (i. e., the northeast trade). After leaving Barbados the northeast trade blew fresh for two days, becoming weaker at about lat. 20° 40′ N., long. 64° 37′ W. While passing Montserrat, and other islands of the same group, cumulus clouds were noted over all of them, especially over the higher mountains, while the rest of the sky was cloudless. Over Mt. Misery, on the island of St. Kitts, a fine heavy cumulo-nimbus cloud was seen at 5 P. M., August 30, and a similar condition was observed over the island of Nevis, earlier in the afternoon.

Several attemps to photograph these clouds failed. The "West Indies Pilot," Vol. II, notes the fact that Mt. Misery is almost always in cloud. It was perfectly obvious that these mountainous islands are very effective in provoking rainfall in the trade winds which blow over them.

With further progress toward the north the temperature gradually fell, to below 80°; the northeast trade diminished in velocity. On September 1 and 2 (lats. 25°-29° N), the wind was light, generally northeast; there was a good deal of calm; the barograph trace showed that the crest of the North Atlantic anticyclone had been passed; the weather was typical Horse Latitude weather, with small cumulus clouds. On September 1 the writer's note-book records: "No finer afternoon on the whole voyage." At sunset on that day the "green ray" was very clearly seen.

Gradually, as the steamer proceeded northward, the signs of the tropics disappeared one by one; the diurnal variation of the barometer gave way to the irregular fluctuating curve of our home latitudes; the wind shifted to northwest, and then southwest; alto-cumulus, strato-cumulus and other temperate latitude clouds appeared; the temperature fell to that which had last been recorded soon after leaving Rio. In a thick fog, such as is unknown over the southern oceans where the summer had been spent, the "Voltaire" steamed slowly toward New York harbor, and anchored off Sandy Hook Lightship about midnight, September 4. The blowing of many fog-whistles all through that evening and night served to emphasize, in a striking way, the meteorological controls over ocean navigation. It seemed to the writer a singularly fitting ending to a summer which had been spent in a study of weather.

ELEMENTARY WEATHER OBSERVATIONS

By ROBERT M. BROWN,
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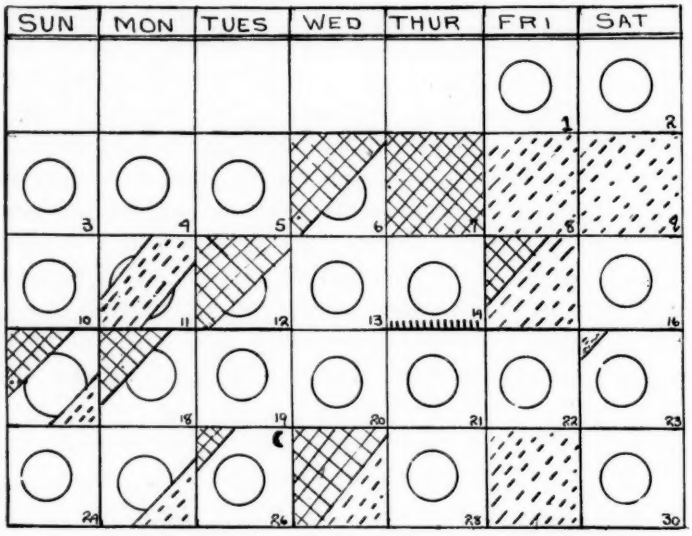
I

THE board calendar on which is recorded the larger features of the atmosphere is in extensive use in the elementary schools. There is a great variety of devices and legends displayed in color which attracts the attention and which makes an easily-read summary of the weather of any month. Although teachers have shown great ingenuity in the construction of the calendar it is to be deplored that so little use is made of the records of the months to teach the main trend of meteorology. When one month's calendar is completed it is frequently erased, and a valuable record is lost, to make room for the next month's calendar. It has been asserted that the object of the work is the training of the powers of observation: but the re-

ply to this assertion is that the means have signally failed in so far as atmospheric features are concerned, for very few people pay the slightest attention to the weather beyond the responses to the obvious conditions of wet and dry or cold and warm. Furthermore the bulk of superstition and currently accepted notions is large among adults. Or, like Darwin, the schools have "worked on true Baconian principles, and, without any theory, collected facts on a wholesale scale"; they have forgotten or never knew that Darwin, when he had gathered his facts, did not erase them from his sight forevermore: he used them to reach his conclusions and to formulate his theory. Many teachers have neglected the aim of all the early observation lessons in the sciences, especially those which fall under the head of nature studies. In geography this work must be largely inductive and



BOARD CALENDAR FOR SEPTEMBER, 1911
Circles, Sunshine. Dotted Areas, rain. Cross-lined Areas, Cloudy. Frost indicated on 14th. Crescent moon on 26th.

the observation is the preparation which has for its purpose sooner or later generalizations which knit together the uncorrelated observations of a period of weeks or months. I fear that in many instances the teaching of weather is inefficient because of the failure to reach general principles, and I know many instances where valuable data of weather observations have been considered as serving their use when the last square of the month is completed. I protest against this waste of time and prodigality of collected facts.

I can do no better than to illustrate by an example the use of a simple board calendar and the value of the records. The above calendar is the record of sunshine and state of sky for the month of September, 1911, in Worcester, Massachusetts. On the blackboard the calendar is much

more effective in presenting the data than any black and white reproduction can be: the sun can be colored yellow or orange, the cloudy days shaded with white crayon and the rainy days indicated by dotted lines or an umbrella. When the month is done the record should be faithfully copied on paper—large enough to be seen from every seat in the room—and filed for reference and comparisons. The first frost is indicated on the calendar on the 14th by hachures. From a single month's record, generalizations are, of course, unsafe, but this is part of the teaching, and in addition the problems which can be suggested will add zest to the work on the calendar in succeeding months. I find no more effective framing of these conclusions than the currently accepted notions about the weather which are found in the rich lore of meteorology.

Following are a number of problems which are suggested by the September calendar:

1. There is a saying,

"If it rains on the first Sunday of the month, it will rain every Sunday of the month."

and, conversely, it is currently reported,

"If it is clear on the first Sunday of the month, it will be clear every Sunday during the month."

The first Sunday of September was clear, the second was clear, the third was cloudy in the morning, the sun came out for a brief period at noon and rain fell in the afternoon, and the fourth was clear. The final solution of the problem is safe only after a number of months has been inspected for comparison; but the September record seems to be a possible argument against such a generalization. The same statements are made sometimes about Friday, and the September calendar argues strongly against such a saying.

2. The first frost occurred in Worcester on the second Thursday, the 14th. People have remarked that it was early this year. If the schools had on record September calendars for a series of years, the simple query would be solved in a logical manner. The first frost during 1910 occurred on October 12th and the average time of the first frost in Worcester is about September 23rd. This later date could be approximated by a series of calendars.

3. There is a saying,

"Wednesday clear; clear until Sunday."

The first Wednesday and the remaining days of that week can be considered in this connection.

4. It is a current saying that

"September 15th is said to be a fine day six years out of seven." September 15, 1911, was a stormy day. Let us look up our records for previous Septembers. Let us save this record for the coming Septembers for comparison.

5. "As September, so the coming March."

We get an interest at once in the March record.

6. "Heavy September rains bring drought."

The average rainfall for September in the Worcester region is about 3.9 inches. Previous charts would show whether the percentage of days of sunshine or rain was greater or smaller. The precipitation for this month was larger than the average, the record being 4.2 inches. Some of the showers were unusually heavy, as the shower of the afternoon of the last Monday of the month when an inch of rain fell in about one-half hour. This, then, gives us our premise of "heavy September rains." Our problem is to watch and take note of the months to come.

7. The equinoctial storm.

The sun was at the autumnal equinox on September 23rd, the fourth Saturday. A slight shower occurred on the morning of that day and heavy showers of short duration on Monday and Wednesday afternoons following; and the nearest storm of any length occurred six days after September 23rd, on the last Friday of the month. It is obvious that, in connection with all these problems, no single month's record is going to settle the question, so a single September record will not be a true guide to a just estimate of this very common belief. March and September records should be saved so that a large number of independent testimonies may be had for the basis of the generalization.

8. "If the new moon appear with the points of the crescent turned up the month will be dry. If the points are turned down, it will be wet."

The crescent moon, four days old, was seen on the last Tuesday of the month. Let us make note of the position of the crescents and the type of weather following during the year.

These are a few of the suggestions which may be used to improve the work in weather observations. I have touched upon the sun and rain record only. I believe the board calendar has possibilities in the grades far ahead of the generally recommended tables for weather data. Further suggestions and the enlargement of the scheme will follow using the October, 1911, calendar as the basis.

(*To be concluded*)

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CLIMATE AND HISTORY

By A. T. OLMSTEAD,
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THERE is no science which has added more to the proper understanding of history than geography, and no influences have been more emphasized than those which we may call geographical, taking this to mean all those influences exerted on man by his material environment. And the historian has gladly welcomed these new ideas though he has often had to qualify or minimize the extent of the effects claimed. Historical geography is no longer, as in the days of Freeman, a question primarily of the advance or retreat of certain red or blue lines on the flat, table-like surface of the map. We have learned that the only map worthy of the name is the contour one, that the lay of the country conditions the lines of development, that many details of history can be understood only by reference to some definite fact of geography, and that the country has a definite and permanent effect on the inhabitants. But the historian has also learned that we are frequently to use the word 'may' rather than 'must,' for there is much which cannot be explained in terms of geography and we must beware of ascribing to material influences those facts which are to be understood—and they are the most important to the historian—in terms of mind. And even then we cannot be sure that certain results follow certain physical causes unless we can prove that these circumstances actually had the opportunity to exert themselves on the race a sufficiently long time to produce such results. This last becomes at once evident when we remember that very few races, if any, are native to the country they now occupy, and that all nationalities today are badly mixed, being composed of the most diverse elements.

As one of these geographic influences, climate has not been neglected by the historian. It has long been recognized that it has important effects upon the inhabitants, but also that the most important effects result only when those inhabitants have long occupied the country. Egypt affords an excellent example of the value of climatic study in this connection and also of its dangers if not used in the light of history. Here we have a hot, dry climate where the main dependence for the crops is not on the rains but on the rise of the Nile. This rise, regular as the seasons, the comparatively small change in temperature among the seasons themselves, the almost complete absence of rainfall, taken in connection with the fertility of the soil and the small number of staple crops, has produced a condition of affairs in which all that is demanded is a steady carrying out of a routine which never changes and requires rather brawn than brain. This we find admirably reflected in the character of the peasantry, now, as in antiquity,

interested only in the securing of enough food to live and to marry upon. But this did not seriously modify the character of the ruling class for, from pre dynastic times, they have always been foreigners. Accordingly, their character has always been that formed in other countries. Only one effect should be noted. Just because they did not adjust themselves to the climate, they became enervated and finally were killed off. In other words, the climate had only a negative effect on the men who have made Egyptian culture worthy of our study. And, since history means evolution, the unchanging peasantry, who show most strikingly the effect of climate, need be mentioned once only by the historian, after which their existence may be assumed for the further historical relation.

Closely similar conditions hold good in Assyria and Babylonia but certain complications make discussion inexpedient here. In Syria and Palestine, on the other hand, the most striking climatic fact is the great difference to be found in so short a journey as to make it difficult to assume that any people or segment of people, be it never so small, was under the influence of any single type of climate. Perhaps such influence is best seen in the Jordan and Dead Sea depressions where the intense heat, joined to great humidity and atmospheric pressure, has always conduced to lowered vitality and lowered morality. Because of this, the valley has rarely been cultivated to its limit, in spite of its fertility. The Philistine plain has had all the advantages without the disadvantages of the Jordan valley, a good soil with warm but healthy climate. Here have always been the greatest cities, made so almost as much by the rich agricultural section back of them as by their position on the greatest trade route of the ancient oriental world. The more temperate climate of the hill country of Judah has assisted in producing the brave and warlike Hebrews. But it is equally to the point to notice that the Philistines were even more warlike, for here the climate had to give way to the character already formed at the time the Philistines conquered the land. And one must always wonder just how much of the character of the real Hebrews, that is to say, of the conquering tribes as distinguished from the conquered and assimilated Canaanites, was formed in the land of Palestine and how much is to be rather referred to their earlier desert homes. At any rate, the influence of the desert is felt in Palestine even where its dry bracing air does not actually affect its climate.

Such are a few illustrations, taken from the Nearer East, as to the influence of climate on a people. But it should be noted that these are influences on the general character of the inhabitants, slow in their operation, and, aside from purely negative results, not affecting the conquering races; in other words, the historian has not hitherto found it necessary to introduce climatic change into the main current of his history. But a new theory, popularized by Professor Huntington in his work, Palestine and

its Transformation, has gone much farther in asserting that the most important movements of history have been caused primarily by climatic changes. So revolutionary a theory demands that we test it as rigidly as possible. Professor Huntington is at home in Western Asia and has therefore attempted to explain certain portions of its history in terms of climatic changes. As one who has devoted his life to the study of the history of Western Asia in antiquity and who has had exceptional opportunities for a detailed survey of the countries through the Cornell expeditions, the present writer may perhaps be permitted to test these theories by the historical facts as certified by the latest historical criticism.

Leaving out of consideration the question as to whether the theory does not attempt to explain by climate facts better explained by other geographical causes, let us see how the facts of history fit it. First of all, we must remember that cultural conditions are today, in many parts of Western Asia, much below those obtaining in antiquity. It is a commonplace that protection is the first function of government. This is not given in many parts of the Turkey of today, in spite of great advances made in the last half century. Then the soil of the plain of Esdraelon and of the Hauran was as rich as it is today. Yet then they were almost entirely uncultivated while now Esdraelon is a garden spot and the Hauran is the granary of the Turkish Empire from which trains carry loads of grain only equalled by those borne to the sea coast by caravans of camels. With the advance of Turkish occupation along the borders of the desert, towns have sprung up which remind us of the boom towns of our frontier. There is no more water in the wells of Beersheba than there was a few years ago when Bedawin with their flocks occupied the site. But the Turkish government has afforded a fair degree of protection and Beersheba is in a fair way to rival its somewhat overestimated past.

In all this discussion, there is one fundamental fallacy, the belief that Palestine and its surrounding countries were in antiquity rich soiled, that this soil has much degenerated, that this degeneration is due to climate, and that the soil today is worked to anything like its full cabapilities. To consider the last point first, it is obvious to any observer that these lands are today badly cultivated. The Philistine plain, for example, is cultivated with as little skill as the most backward American farm. From what we know of ancient agriculture, it is further obvious that it was then possible to apply better methods than are used now. The crops always raised have been just those which most exhaust the soil and the peasant has not realized the need of using fertilizers, green or animal, and of rotating crops. This in itself would gradually reduce the yield as we are already learning even in virgin America. Egypt is the only country where really modern methods of cultivation have been introduced. Though in antiquity they used the best known, it had, as we learn from Diodorus,

who probably had access to the official census taken under Augustus, but five million inhabitants. Now it supports more than twice as many. In all probability, modern methods applied to other parts of our area would give similar results. The small yield then is no argument for a change of climate.

Again, the population of Western Asia in antiquity has been sadly overestimated as has its fertility. Palestine of the ancients was a 'land of milk and honey' only to nomads from the desert. It still gives that impression to one who comes from the steppe. But it is a different matter coming from the more fertile lands, even of the Near East.

Fortunately, we are in a position to estimate with some degree of accuracy how much of the land was actually under cultivation in some parts of our area during ancient times. This we may do by noting the location of the mounds representing the sites of ancient cities, for regions without settlements were hardly cultivated. A striking example is to be seen in northern Mesopotamia, the region south of Mardin and Nisibis. At the point where each small stream debouches from the hills to the north, we find a mound. As these streams come together into the Jaghjagha, the line of mounds narrows until, when that stream flows into the Khabur, it simply follows the river, the mounds being rarely a mile away. The remainder is merely steppe, luxuriant when it rains, burned up the rest of the year. And there are no mounds to indicate ancient cultivation. In other words, the limit of land which could be cultivated was not that of rainfall but of irrigation. These streams still have plenty of water, even in the dry season, but they are now useless for there is no protection against Kurds and Arabs and even the large and well armed caravan must cross with caution. A score of years ago, before the Armenian massacres, many were occupied. The inhabitants were killed and now they are deserted, not from change of climate, but for lack of protection.

And it is not only here that we have evidence that there is still water enough to cultivate the fields cultivated in antiquity and that only a small part was so cultivated. The country between Assyria and Babylonia is as well occupied now as in antiquity, if we are to judge from the absence of mounds in the regions now uninhabited. Cities grew up at the point where the streams debouched from the hills for here the water could be used in the irrigation ditches as it is used today. Further down, the steep banks of the Tigris not only made the waters of the river itself unavailable but also from the tributaries, which had to cut down to it. The east bank of the Tigris is indeed covered in spring with luxuriant grass but the lack of mounds shows that it was as little cultivated in antiquity as now. The ancient mounds are in almost every case represented by towns today and their size is even now, in spite of the lack of adequate protection, almost as great as we can postulate for the ones which formed

the mounds. Here, too, rainfall, then as now, had to be supplemented by irrigation.

The Negeb, the region south of Judah, has played a large part in recent discussion, and indeed a theory has developed that here in antiquity was an important kingdom bearing the same name as Egypt and to which are to be referred many notices hitherto attributed to that country. At first sight, the remains seem to indicate that such a theory may be true and that there has been a change of climate for the worse. But a brief perusal of the Biblical stories dealing with this region will show that it then had the same nomadic population as it has today, or rather, as it had before effective Turkish occupation of the northern portion. Archaeology confirms this, for the complete absence of any mound worthy of the name and the even more complete absence of pottery which can be dated from before the Roman conquest shows that there was no settled population before this time. That under the Roman rule, when a camp was actually established in its center, it was fairly well settled, simply is the result of adequate protection and not of change of climate. That this is so is shown by the already mentioned new development of Beersheba. In spite of the extremely crude methods of the Bedawin, grain is now grown in fairly large quantities and, what is worthy of notice, without irrigation. It is true that there is not much flowing water but there are about a dozen fine springs, some flowing a considerable distance, and the way in which springs and wells are mentioned in the Old Testament shows that in antiquity they were the only reliance. Further, in every stream bed, sweet water can be found by a half hour's digging, even though no water may flow in these beds above ground save after a sudden freshet. There was no river here in antiquity for the word translated as 'river' in the River of Egypt actually means only a dry stream bed. Nor should we forget that these towns grew up, not primarily because of an agricultural country about them, but because they were stations on important trade routes. They need not have secured, and probably did not secure their food supplies entirely from the surrounding regions. The most of them were in all probability little larger than the present day Beersheba, and proper protection will probably give rise to such towns at Aujeh and other ruined sites where Turkish garrisons may be stationed.

Much has been made of the fact that armies crossed the desert and especially that part of it which lies along the great trade route from Egypt to Asia Minor and the Assyrian regions. It has been argued that only under conditions radically different from those obtaining today could armies have crossed the desert in comfort. Fortunately, we have all the data needed to criticise this view. On the one hand, the difficulty has been much exaggerated. Our party actually walked over a good share of this route and we found the ground covered with flowers. Of course, this

was in January, that is, the best season of the year, but the many branching lines of camel tracks showed that it was well utilized, even now when its main reason for existence has been taken away by the use of steam transportation for traffic between Palestine and Egypt. In fact, looking at the evidence of history, we might almost argue that it was more difficult in antiquity than now. Esarhaddon, the Assyrian who conquered Egypt, was forced, he tells us, to carry water in buckets through the desert and he expressly informs us that there was no river there. When the Persians under Cambyses invaded Egypt, they found that it was, to quote the words of Herodotus, "a dry desert without a drop of water," and they could pass it only by arranging with the king of the Arabs to send there all his camels loaded with water skins. And all the later accounts of the armies which crossed this desert tell the same story.

In the lack of definite topographical knowledge, the earlier Assyriologists assumed that Assyrian armies frequently crossed the main Arabian desert, and that caravans likewise did so. But we now know that they never did and that the only one which actually went into the desert at all, that of Ashur bani apal, merely crossed the extreme northern end of the Syrian desert. And even this was an extraordinary expedition for the Assyrian scribes constantly speak of the 'Land of thirst and hunger' and of the lack of water. On other occasions, the Assyrian armies can be traced marching north-west to the extreme north of Syria and then turning south again. Had there been any sort of a route across the desert, this round about way would not have been taken.

We have not the space to further test by historical facts the theory that the Arabian desert with its surrounding lands more occupied, more fertile, and easier of access than it is at the present day. Further examples would only prove that it was not well grounded. And this brings us to our conclusion as regards the question of the relation of climate to history. That climate, working through the ages, has a highly important effect on the permanent population of a country is admitted by every historian. That it has effects, mostly negative, on the transient population has also been seen. At present, the theory of a more immediate influence on the details of history seems to be bound up with the theory of cyclic climate changes and we have seen that the facts of history tend to disprove this. Accordingly, the historian is not justified in utilizing climate for more than the study of the background of his history. For influence on particular events, there are many geographical facts of far more significance.

THE ARABIAN DESERT AND HUMAN CHARACTER

By ELLSWORTH HUNTINGTON,
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Adapted in part from "Palestine and its Transformation."

FOR an hour my guide and I had been wandering in the darkness on the top of the plateau of Moab. A few miles to the west the plateau ended in the steep escarpment which drops 4000 feet and more to the bitter blue brine of the Dead Sea; eastward the sunset light had given us a fine view of the gentle slope which descends by insensible degrees to the great Syrian Desert, a waste of gravel and sand. The region ten or fifteen miles wide between the escarpment and the desert forms a narrow strip of grassland, whose ownership is fiercely debated between settled farmers and wandering nomads. In 1909, the year of our visit, the nomads had the upper hand, for the rains of early spring had failed, the grass had withered, the springs had ceased to flow, and the Beduin had been forced to take refuge in any and every place where they could find a scanty bit of herbage for their flocks and camels and a little water to assuage their thirst. Guided by the barking of dogs we finally came upon a group of about twenty long, low tents of black hair-cloth set in an ellipse a hundred yards long, and lighted by small fires at which the evening meal had been cooked. With the practiced eye of the traveller, my guide, an Arabic-speaking soldier in the Turkish service, picked out the tent of the chief or sheikh. One end of the tent was devoid of any front wall, and was readily recognizable as the men's quarters or guest room. It was crowded with Arabs muffled in woolen cloaks and clustered around a fire of dry weeds whose intermittent flames lighted up a slab of limestone bearing the rudely scratched insignia of the tribe of Beni Sakr.

We dismounted silently, as men do in a land where no man knows whether the stranger is friend or mortal enemy. The Arabs, grouped cross-legged or asquat around the blaze, received us without a word, although the chief men rose and motioned to us to seat ourselves in places of honor. A quilt was brought to spread on the coarse woolen rugs where the rest were seated; and since I was a foreigner and hence a guest of distinction, another was rolled up so that I might rest my left elbow upon it. Only when we were comfortable did conversation slowly begin. At first the subject was roads and villages, but soon we touched upon the Arab's perennial topic, his quarrels with the government. As the sheikh told how he and his people had fought with the Turkish soldiers not many years ago his eyes grew so fierce and his gestures so violent, that I should have feared we would be murdered, had I not known that an Arab never does violence to his guests. With all his soul, so he said, he hated the

uniform of my guide, although the man himself was good apart from what his clothes implied. 'Why does the government take taxes from poor Arabs who come from the desert in times of drought?' he fairly hissed. "Have not the Arabs the right to feed their flocks wherever there is grass? Some day soon the soldiers will see what my people will do."

While we conversed the inevitable coffee had been circulating, a strong black decoction, patiently brought to a boil half a dozen times, and then served in two little china cups from which one after another of the twenty guests drank in succession. Then the evening meal was served, a tender lamb freshly killed and boiled for our benefit. We pulled it to pieces with our fingers, as the custom is in the desert. With it were served thin sheets of unleavened bread, good not only as food but as scoops wherewith to ladle up sour milk and soft butter. This was no ordinary Arab meal such as is commonly eaten in times of drought, but a feast for guests, and so we were offered still another dish, cracked wheat boiled with a little fat, and eaten with the hands.

When the shiekh was not excited he was an admirable host. Thinking that I might be chilly that April night with the temperature close to forty, he thoughtfully threw over my shoulders a thick Arab cape of wool. Then when we went to bed he took great pains to see that we were warmly covered, especially our heads. Not till he had seen the guide and myself, together with two other guests, comfortably stretched on the ground around the ashes of the coffee fire and apparently asleep with our heads resting on saddles, did he retire to his own part of the tent.

As the fire faded the beauty of the clear moonlit night was more and more apparent. The occasional faint bleat of a young lamb or the suppressed bark of a dog only emphasized the stillness. Then, suddenly, the sound of guns rent the air, dogs began to bark wildly, men shouted, and the shrill cry of women arose. The camp jumped to its feet in a moment; the men flung their striped white and brown cloaks over their shoulders, slipped their feet into low shoes, if they had any, and with guns in hand hastened away on foot or on the camels and horses tethered near the tents. Before I could put on the clumsy boots which civilization entails upon us, they had gone off toward the southeast, followed by a crowd of women. Then there was silence once more; almost before I understood what had occurred the excitement had subsided. In the bright moonlight the women, with queenly gait and haggish tattooed faces, could be seen streaming down the hillside in their trailing garments of dark blue. Nothing unusual had happened; it was merely a "ghazzu," or raid. The Howeitat Arabs, enemies of the tribe of Beni Sakr, and likewise suffering from the drought, had come in from the desert to the region where water and grass

were to be found. That night they raided their neighbors and drove off a herd of a hundred or more camels which had been rounded up at a little distance from the tents.

To occidentals such a raid seems exciting, and the raiders seem to be guilty of a great crime. Not so to the Arabs; they live in constant expectation of such events. When the two gray-bearded men who were our fellow-guests were awakened by the guns, they merely sat up, realized what had happened, and lay down once more to sleep. It was nothing to them if other people's camels were stolen. Here was no matter of right and wrong, nothing demanding redress. If they should help recover the camels, they might themselves incur emnity or even become involved in a blood-feud with the raiders. Perhaps it would be their own turn to be raided tomorrow, and then they would exert themselves, but rather, since raids were in progress, they hoped that they soon might engage in one on their own account. Neither their help nor ours was expected nor wanted by our hosts. So in the chill, damp morning, without washing or eating, or speaking to anyone, we all took our horses and rode away, for the men of the camp were gone, and the women have naught to do with guests.

Five times in the spring of 1909 I came directly in contact with Arab raids on the borders of the Syrian desert. Once we were returning to Homs from the ruins of Palmyra in the desert, whither we had driven in a carriage which easily traversed the smooth expanses of gravel even although there was no road. At one place we turned aside for some miles into the mouth of a mountain valley. After examining the ruins of a village, once well watered, but now absolutely waterless, we were ready to proceed. It appeared that if we could get the carriage over a spur a mile or more ahead, a detour of six or eight miles could be avoided; and accordingly one of our two soldiers was sent forward on horseback to reconnoitre. Two hours and a half passed and he did not return, so finally the other soldier was sent to find him. At length the two horsemen returned after another hour or more. The first soldier looked much disturbed, and there was an empty space in his cartridge-belt. At first he was uncommunicative, but finally he told his tale: "When I reached the top of the ridge yonder, I found that the carriage could cross it, but there was another ridge a little farther on. I went to look at it, and found that the path was too rocky for wheels. When I turned back I saw ten or twelve Arabs in the valley below me, and I knew they were raiders. I hid among the rocks, and then I was afraid that they had seen me and would climb up another way and catch me; so I got behind a safer rock and fired eleven shots at them. I did not hit anybody and they went off, but I dared not come out from my hiding-place until my companion appeared on the other ridge."

Doubtless the Arabs were raiders, as the soldier thought, but his action in shooting at them was idiotic. Luckily, to use a somewhat Irish expression, they did not know how many of him there were, and so did not attack him. If he had killed anyone, a blood-feud would have arisen, which would probably have cost the soldier his life and might have cost ours. His conduct illustrates the bitter hatred which prevails between the wandering Beduin of the desert and the settled peasants of the same stock and language who live on the edges of the desert and are now under Turkish rule. The soldier had not a particle of shame in saying that he had fired eleven shots at a party of men of his own race whom he had never before seen, who had done him no harm, and with whom his government was at peace. He was ashamed of his fear and of his failure to hit the mark, but he was proud of that which we would call a deliberate attempt at manslaughter.

No argument is needed to prove that the moral standards of the desert are vastly different from our own. What seems absolutely wrong to us seems not only right but laudable to them. To what shall we ascribe this? Is it due to the teachings of Mohammedanism, to the innate character of the Arab race, or to some other external cause? Potent as religion and race may be, there is ground for believing that many of the most prominent Arab traits have been caused or at least fostered by the hard conditions imposed by the desert climate.

Consider what happens to an Arab nomad during the course of a year. In the spring when the camels, goats and sheep are giving abundance of milk he lays up a store of sour cheese and curds, dried hard as the toughest hardtack. Then when the summer comes he exchanges his surplus animals, chiefly the young males, for dates, wheat and rice grown in the oases or in the border lands where agriculture is possible. A few animals may be saved for future use as food, but only the most wealthy can afford to eat meat often. In good years the ordinary Arab can lay by enough food to last himself and his family until the following spring. Suppose, however, that the year has been dry, and many of the young animals have died on the one hand, and the price of dates and wheat is high because the crop is scanty on the other hand. In that case a large number of the nomadic Arabs are unable to lay by food enough to last them later than perhaps February, the time when the rains ought to come and the young sheep and camels to begin to be born, and milk to be abundant. If all goes well it is possible to live through the spring on nothing but milk. The Arabs do this frequently, although they do not enjoy it. Doughty, in his vivid account of Arabia, tells how some Arabs who had long been living on milk pined for something else. "Give us bread," was their cry. "For two months we have drunk this vile milk. Our stomachs are empty and we cannot fill them. Let us have something that we can

set our teeth into, something that has some substance." Suppose further that when the time comes for the young animals to be born and for the abundant milk of the spring to supplement or replace dates and bread, no rain has fallen. No wonder the Arabs are anxious. No wonder Doughty found that when he met strangers the first question was: "Where is the rain? Have showers fallen anywhere? Is there grass in any part of the land? How far to the place of the shower? Did it extend wide over the country? Why does Allah withhold the rain so long?" Imagine the state of people who eagerly pack their tents and all their crude belongings upon camels and travel one or two hundred miles simply because they have heard that a little shower has fallen over an area no larger than that watered by a single summer thunder storm in America. Yet this is a common occurrence in Arabia. Often, indeed, the showers are so scanty that the pools are not filled, and the grass springs up so sparsely that to the eye of any but the sons of the desert it is invisible; and even to him it becomes invisible as soon as its scanty spears, two or three inches high, wither in the scorching sun. When such years come, as they often do, the mother animals can find no fresh pasturage; they may subsist themselves, but they have no milk for their young. Animal after animal dies. The Arabs see that they can lay by no curds and cheese for the winter; but that is far from the worst. They see also that they will have no surplus animals to exchange for dates and wheat. And worst of all they see their own children hungry and crying for food. This is no over-drawn picture. It is exactly what happens every time that two or three exceptionally dry years come in succession.

What is an Arab to do when his camels, his sheep, his wife, his children and himself are all suffering the pangs of hunger? He cannot go off to some other land and get work. In the first place he hates the thought of steady work because he has never had occasion to practice it. In the second place there is no work to be had, for at the time when he is in distress the countries round about are also suffering from drought. And finally, unless he absolutely gives up his old life he must stay with what animals he has left and care for them as the basis of any prosperity for which he may hope in the future. The only resource under such circumstances is plunder. The man who is starving has little thought of right or wrong. To have such thoughts would seem to him fatal. If considerations of humanity or any other moral ideas prevent him from engaging in raids upon the tribes around him, the doom of his family is sealed, for his children die of hunger. Thus through the thousands of years since Semitic nomads first lived in Arabia the hard conditions of climate have steadily weeded out all who withheld their hands from violence.

The man who would succeed and who would keep his children in health must not only be ready to commit depredations and be utterly dis-

honest according to our standards, but he must also be strong in the endurance of heat, thirst and the weariness of long rides. Unfortunately, however, he has little need of steady industry, or of strength to endure long physical labor. In a word laziness, according to our definition of the word, is no great disadvantage provided a man is able to summon up his powers in a crisis when the camels have strayed far away, when they have been driven off by raiders, or when the man himself goes on a foray. Hence the Arab is lazy as well as utterly disregardful of the commonest principles of honesty. Just as he thinks of raids as a part of the ordinary routine of life, so he thinks of steady work as something scarcely to be demanded even of women and as fit only for slaves.

The completeness with which the activities of the Arabs are controlled by the dry climate of their country is illustrated by the fact that their raids, like the majority of human actions, are timed according to the earth's rotation and the inclination of its axis. As a rule the Beduin make raids upon one another rather than upon the sedentary population who are protected by their villages. On long raids the plunderers often ride three or four hundred miles to the scene of operations. To be successful they must have camels to endure thirst and to travel hard on little food, and horses to use in the final dash, when speed and docility are required in order to round up and drive off the camels or other animals selected as prey, or to ride down escaping victims. The mares, however, which are the only horses kept by the Arabs in any numbers, cannot endure long marches without drinking. Accordingly each Bedui in a well equipped party takes a milch camel and a mare which has been taught to drink camel's milk. He rides the camel on the long marches, and where water is scarce uses its milk to supply himself and his horse with both food and drink. Only when the camel foals are several months old can the mothers safely be taken from them. Hence May and June are the great season for raids. Earlier than this not only do the Arabs hesitate about taking away the mother camels, but the business of taking care of the young animals is too engrossing to permit of many raids. Later, during the hot, rainless summer, many springs and wells dry up, and this not only makes it hard to travel across the desert, but obliges the Arabs, both the plunderers and the plundered, to concentrate around the larger supplies of water. Raids thus become more difficult because so many people are together and because the distance to be traversed from water to water is so great.

Wherever we turn among the Arabs we find habits and traits which have either originated because of the desert environment or have been preserved by it through the process of natural selection. In addition to predatory habits, dishonesty, and laziness, other traits such as democracy are dependent upon climatic environment. In a country so dry as Arabia

the vast areas outside the oases cannot possibly be inhabited except by nomads. Now nomads who change their domicile every few weeks cannot have large dwellings nor abundant furniture. Their possessions of all kinds must be packed into small compass on the backs of camels. Hence between the poor and the rich there cannot be great differences, such as those which exist in settled communities where one man may live in a palace of a hundred rooms and another in a one-room hovel eight feet square. Another factor tending toward democracy is the constant raids. The rich man and the poor are equally liable to the loss of all their wealth whenever raiders carry off the camels. This complete loss of property, this levelling of all grades of society to the plane of direst poverty is so common that there has grown up among the Arabs a peculiar kind of generosity. When a man has been robbed it is the common custom for the men of his immediate tribe to contribute camels according to their means to start him once more toward prosperity.

Finally one more characteristic feature of Arabia is plainly the result of its climate. In Arabia we have one of the purest races in the world. From the beginning of time Semites have dwelt in the land and Semites still dwell there. The explanation is simple. Throughout the course of history fertile, well-watered countries have been the goal of migration after migration, as may be seen in the case of India. From all parts of central Asia stratum after stratum of Dravidian, Aryan, Turanian and Mongolian peoples have come into the land. Their diversity, coupled with the extreme diversity of the country itself, has given rise to a highly complex mixture of races, and to very great differences between people of the same race, some being high and some low in the scale of civilization. This in turn has been one main cause of the existence of caste as a religious system. In Arabia, on the contrary, the climatic conditions have been so adverse that no migrations have ever been directed into the country, although many have been directed outward. Hence there has never been any mixture of races, nor has a ruling class of alien blood ever possessed the land; and this has co-operated with other factors in making the Arabs democratic. These conditions appear to have had an important influence upon Mohammedanism. In India, as we have just seen, the high development of the caste system in the Hindu religion has been closely connected with the fertility and variety of the land and with the numerous invasions which have been directed into it. In Arabia, on the contrary, the uniformity of the various parts of the country and the arid conditions which have kept people poor and have prevented immigration, have been one of the important causes of the democratic character which is more marked in Mohammedanism than in any other of the world's great religions.

A NEW FORM OF "TEST"

AT the December (1910) meeting of the American Federation of Teachers of Mathematical and Natural Sciences, Professor E. L. Thorndike of Columbia University, proposed several novel methods of testing pupils. One of these methods has suggested the following set of statements. Some of these statements are true and some are manifestly absurd to one who understands the principles involved. A pupil who understands the principles or facts involved will readily detect the absurd statements. In this form of test, all the pupil is asked to do is to mark the untrue statements. No writing on his part is called for and the teacher can afterward grade the papers very rapidly. This kind of test puts a premium upon positive knowledge, and readily catches the bluffer. It is not, of course, recommended as a sole method of examining pupils.

Pick out the absurd statements below:

1. Being near the ocean, Ireland naturally has extremely cold winters.
2. Mountains in the Trade Wind belt have heavy rainfall on their western slopes.
3. The monsoon, blowing from the Indian Ocean in winter, brings moisture to India.
4. St. Louis, situated in the interior of a continent, is relatively free from sudden and extreme weather changes.
5. The high mountain range in western Washington is one cause of the heavy rainfall in the eastern part of the state.
6. The mercury in our thermometers fell as the balloon ascended.
7. As the balloon descended, the mercury in our barometer rose.
8. We were in Cape Town on July 4th and it snowed hard.
9. Since the region is in the Belt of Horse Latitudes, frequent rains are to be expected.
10. We have our winter when the earth is nearest the sun.
11. Fruit growing is naturally more successful on the eastern shore of Lake Michigan than on the western.
12. Being nearly surrounded by water, Italy has an equable climate.
13. The cyclonic storms which pass from east to west across the United States often cause rapid changes in weather.
14. The chemicals used by the firemen liberated much oxygen and quickly extinguished the fire.
15. Because of the somewhat rarified atmosphere over deserts, the nights are warmer than normal.
16. The rising air currents over the equatorial belt lead to a deficiency of rainfall there.
17. Since Memphis receives the direct rays of the sun in summer, the days are very hot.
18. As we traveled southward in Argentina the climate naturally became colder.

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